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Docket No.: MUH-12841

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MAIL STOP: APPEAL BRIEF-PATENTS

By: _____ Date: March 12, 2007

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
Before the Board of Patent Appeals and Interferences

Applic. No.	:	10/686,849
Inventor	:	Anton Mauder et al.
Filed	:	October 16, 2003
Title	:	Ohmic Contact Configuration
TC/A.U.	:	2814
Examiner	:	Long Pham
Customer No.	:	24131

Confirmation No.: 1748

Hon. Commissioner for Patents
Alexandria, VA 22313-1450

APPEAL BRIEF

Sir:

This is an appeal from the final rejection in the Office action dated September 11, 2006, finally rejecting claims 1, 5, 8-11, and 15-23.

Appellants submit this *Appeal Brief* including payment in the amount of $500.00 to cover the fee for filing the *Appeal Brief*.

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Real Party in Interest:

This application is assigned to Infineon Technologies AG of Munich, Germany. The assignment will be submitted for recordation upon the termination of this appeal.

Related Appeals and Interferences:

No related appeals or interference proceedings are currently pending which would directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

Status of Claims:

Claims 1, 5, 8-11, and 15-23 are rejected and are under appeal. Claims 2-4, 6-7, 12-14, and 30-31 are cancelled. Claims 24-29 and 32-37 are withdrawn from consideration.

Status of Amendments:

No claims were amended after the *final Office action*. A *response under 37 CFR § 1.116* was filed on November 21, 2006. The Primary Examiner stated in an *Advisory Action* dated January 5, 2007 that the request for reconsideration has been considered but did not place the application in condition for allowance.

Summary of the Claimed Subject Matter:

Independent claim 1 recites a contact configuration (see page 1, lines 8-9 of the specification), comprising:

a semiconductor body (1) of semiconductor material in a monocrystalline phase (see page 15, lines 20-22 of the specification), said semiconductor body having one of a trench component and a planar component formed therein, said component being selected from the group consisting of a diode, a bipolar transistor, a MOSFET, and an IGBT (see Figs. 2-4, page 16, line 10 and page 17, line 7 of the specification as well as the original claims 13-14);

a metalization layer (3) formed of a metal selected from the group consisting of aluminum, chromium, and aluminum/chromium (see Figs. 2-4, page 16, lines 4-6 of the specification as well as the original claim 12); and

a layer (2) of said semiconductor material in a substantially amorphous phase disposed between said semiconductor body (1) and said metalization layer (3), for forming an ohmic contact between said metalization layer (3) and said semiconductor body (1) (see Figs. 2-4 and page 1, lines 9-10, page 15, lines 19-20, and page 17, lines -20 of the specification);

said semiconductor material being silicon and said layer being a layer of amorphous silicon doped with hydrogen (see page 15, lines 20-23 and page 18, lines 5-8 of the specification as well as the original claims 2-3).

Grounds of Rejection to be Reviewed on Appeal

1. Whether or not claims 1, 5, 8-11, and 15-23 are patentable over Sato et al. (US 6,440,828) in combination with Cheng et al. (US 5,873,984) and Slater, Jr. et al. (US 2004/0171204) under 35 U.S.C. § 103(a).

Argument:

Claims 1, 5, 8-11, and 15-23 are patentable over Sato et al. in combination with Cheng et al. and Slater, Jr. et al. under 35 U.S.C. § 103(a)

In second paragraph on page 2 of the final Office action dated 09/11/2006, claims 1, 5, 8-11, and 15-23 have been rejected as being unpatentable over Sato et al. in combination with cheng et al. and Slater, Jr. et al. under 35 U.S.C. § 103(a).

Before discussing the prior art in detail, it is believed that a brief review of the invention as claimed, would be helpful.

Claim 1 calls for, inter alia:

> a semiconductor body of semiconductor material in a monocrystalline phase, said semiconductor body having one of a trench component and a planar component formed therein, said component being selected from the group consisting of a diode, a bipolar transistor, a MOSFET, and an IGBT;
>
> a metalization layer formed of a metal selected from the group consisting of aluminum, chromium, and aluminum/chromium; and
>
> a layer of said semiconductor material in a substantially amorphous phase disposed between said semiconductor body and said metalization layer, for forming an ohmic contact between said metalization layer and said semiconductor body;
>
> said semiconductor material being silicon and said layer being a layer of amorphous silicon doped with hydrogen.

The invention of the instant application relates to a contact configuration for a semiconductor device in which a layer (2) is disposed between a monocrystalline semiconductor body (1) and a metalization layer (3) for forming an ohmic contact therebetween. The layer (2) is formed from the semiconductor body in an

amorphous phase. The amorphous phase is formed of silicon so that amorphous silicon is used for the amorphous layer, which is doped with hydrogen.

Sato et al. describe an ohmic contact having a metallization layer formed of titanium silicide on an amorphous silicon region, which was made amorphous by ion-bombardment and directly borders the silicon body (see the abstract).

Therefore, the invention of the instant application differs from Sato et al. in that the invention of the instant application contains the additional feature that the amorphous layer is doped with hydrogen. A good ohmic contact between the amorphous silicon and the semiconductor body as well as between the amorphous silicon and the metalization layer can be guaranteed through the doping with hydrogen (see the paragraph bridging pages 6 and 7 of the specification).

The Examiner has stated in the final Office action dated 10/14/2005 that Cheng et al. disclose doping with hydrogen. However, Appellants believe that the combination of Cheng et al. and Sato et al. is inappropriate because Cheng et al. relate a method for sputtering an amorphous carbon overcoat as a protective film on a magnetic recording disk and have nothing to do with a semiconductor device. Also, it can only be obtained from Cheng et al. that a doping with hydrogen serves for improving the mechanical properties in an amorphous carbon overcoat.

A person skilled in the art, when striving to improve the ohmic contact making between a metalization layer and a semiconductor body, would not consider any literature that concerns magnetic recording disks and their mechanical properties.

Slater, Jr. et al. describe a backside contact for vertical devices in which an ohmic contact making between an implanted silicon carbide and a deposited metal is produced. However, Slater, Jr. et al. do not deal with an amorphous layer formed of the material of the semiconductor body formed of silicon.

In the final Office action dated 09/11/2006 and in the Advisory action dated 01/05/2007, the Examiner has maintained that Cheng et al. teach the doping of an amorphous silicon layer with hydrogen for improving mechanical property.

As already discussed above, Appellants believe that it is incorrect to cite Cheng et al. as relevant prior art. Cheng et al. describe a method of sputtering an amorphous carbon overcoat as a protective film on a magnetic recording disk. In order to improve the mechanical property of this amorphous carbon overcoat, hydrogen and nitrogen are introduced in the sputtering chamber so that an amorphous C-H-N film results, which exhibits superior mechanical and tribological properties (see column 2, lines 23-43).

It is not understandable why the teaching of Cheng et al. (amorphous carbon overcoat is provided with hydrogen and nitrogen for improving the mechanical property) would suggest a person skilled in the art, who wants to produce an ohmic contact between a metalization layer and a silicon body with low emitter efficiency, to introduce hydrogen into amorphous silicon.

The primary object of the present invention is not to improve the mechanical property of an amorphous film. Rather, the present invention aims at a good ohmic contact between a metalization layer and a semiconductor body consisting of, as a rule, silicon, whereby a weaker emitter efficiency is desired (see the second paragraph on page 4 of the specification). Thus, the present invention aims primarily at an improvement of the electrical property and not an increase of the mechanical stability.

Moreover, the Examiner should know that the carbon overcoat of a magnetic disk fulfills a totally different function as an ohmic contact at a semiconductor body.

Although the prior art motivation or advantage may be different than that of applicants', the prior art reference must be analogous in order to be relied on as a reference under 35 U.S.C. 103.

It is accordingly believed to be clear that none of the references, whether taken alone or in any combination, either show or suggest the features of claim 1. Claim 1 is, therefore, believed to be patentable over the art and since all of the dependent claims are ultimately dependent on claim 1, they are believed to be patentable as well.

The honorable Board is therefore respectfully urged to reverse the final rejection of the Primary Examiner.

Any fees due should be charged to Deposit Account No. 12-1099 of Lerner Greenberg Stemer LLP.

Respectfully submitted,

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YC/sms

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Claims Appendix:

1. A contact configuration, comprising:

a semiconductor body of semiconductor material in a monocrystalline phase, said semiconductor body having one of a trench component and a planar component formed therein, said component being selected from the group consisting of a diode, a bipolar transistor, a MOSFET, and an IGBT;

a metalization layer formed of a metal selected from the group consisting of aluminum, chromium, and aluminum/chromium; and

a layer of said semiconductor material in a substantially amorphous phase disposed between said semiconductor body and said metalization layer, for forming an ohmic contact between said metalization layer and said semiconductor body;

said semiconductor material being silicon and said layer being a layer of amorphous silicon doped with hydrogen.

5. The contact configuration according to claim 1, wherein said silicon semiconductor body is n–conducting in a region of said layer of amorphous silicon.

8. The contact configuration according to claim 1, wherein said silicon semiconductor body is p–conducting in a region of said layer of amorphous silicon.

9. The contact configuration according to claim 1, wherein said layer of amorphous semiconductor material has a thickness in the order of magnitude of nanometers.

10. The contact configuration according to claim 9, wherein said thickness of said layer lies between 2 and 100 nm.

11. The contact configuration according to claim 1, wherein said layer of amorphous semiconductor material has a doping of between 10^{15} and 10^{16} charge carriers per cm^3.

15. The contact configuration according to claim 1, which comprises a field stop zone in said semiconductor body, said field stop zone adjoining said layer of said amorphous semiconductor material.

16. The contact configuration according to claim 1, which further comprises an additional layer in said semiconductor body in a region of said layer of amorphous semiconductor material, said additional layer forming an emitter.

17. The contact configuration according to claim 16, wherein said additional layer and said semiconductor body are of a common conductivity type.

18. The contact configuration according to claim 16, wherein said additional layer and said semiconductor body having mutually opposite conductivity types.

19. The contact configuration according to claim 16, wherein said additional layer is doped so weakly that, without said layer of amorphous semiconductor material, said additional layer forms one of a Schottky contact or an ohmic contact with a relatively high contact resistance.

20. The contact configuration according to claim 1, wherein said layer of amorphous semiconductor material is formed on at least one of a front side and a rear side of said semiconductor body.

21. The contact configuration according to claim 20, wherein said layer of amorphous semiconductor material is formed to locally attenuate an injection of charge carriers in critical component regions.

22. The contact configuration according to claim 1, wherein said layer of amorphous semiconductor material is locally recrystallized.

23. The contact configuration according to claim 1, wherein in said amorphous semiconductor material is silicon carbide.

Evidence Appendix:

No evidence pursuant to && 1.130, 1.131, or 1.132 or any other evidence has been entered by the Examiner and relied upon by appellant in the appeal.

Related Proceedings Appendix:

No prior or pending appeals, interferences or judicial proceedings are in existence which may be related to, directly affect or be directly affected by or have a bearing on the Board's decision in this appeal. Accordingly, no copies of decisions rendered by a court or the Board are available.